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POSTER PAPER

Astronomy and cosmology for children

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Abstract. In the last years there has been an increased interest in tackling the frequent common misconceptions about astronomical notions found both in elementary school students and in their teachers. Research in many countries has shown that basic astronomical concepts like night-and-day cycle, lunar phases, meteors, seasons, etc, are by far not completely acquired by neither of the two groups. We have recently presented a series of Astronomy and Cosmology books aimed at helping both children aged seven years onwards, and their teachers, in subjects covering a wide range of topics, all introduced with carefully chosen words and images that young children can understand. Our aim is manyfold: contribute in getting young students interested about the science of the sky and, at the same time, help to employ Astronomy as a key tool to build up adequate conceptual changes in a whole range of science issues.

Resumen. Desde hace varios años existe un gran interés en mitigar las nociones alternativas más frecuentes que aparecen en temas de astronomía, y que encontramos tanto en alumnos de la escuela primaria como en sus docentes. Investigaciones llevadas a cabo en varios países han demostrado que conceptos astronómicos básicos, como el ciclo del día y la noche, las fases lunares, la naturaleza de los meteoros, las diferentes estaciones del año y muchos otros, están lejos de ser bien comprendidos por ambos grupos de individuos. Hace poco tiempo, hemos publicado una tétrada de libros de Astronomía y Cosmología para chicos (de siete años en adelante) con el fin de ayudar –a ellos y a sus docentes– en la comprensión de una gran variedad de temas, todos presentados con palabras cuidadosamente seleccionadas y con imágenes claras y atractivas que los niños pueden comprender. Se pretende lograr al menos tres objetivos: generar interés en los más jóvenes por la ciencia del cielo, ayudar a limitar la abundancia de nociones no científicas y facilitar el aprendizaje significativo.

1. Introduction

Astronomy in many countries is just a nice way to spend a night below the stars contemplating the universe, but has not found its proper place in basic education. The result is that often, children do not find answers to the many questions that genuinely come to their minds while reading or making observations. More often

than not they learn (or have to accept) what older people –e.g., parents and teachers– tell them, even if sometimes the new notions unconfortably find their place side by side with their previous ideas about the subject.
Recently, an increased interest in tackling the most frequent alternative conceptions about astronomical notions has surfaced. This so-called "unscientific knowledge" was found both in elementary school students and in their teachers. While there have not been many studies in Argentina about this (with notable exceptions, see e.g. Camino, 1995), research collaborations in other countries have shown that the most basic astronomical concepts (let alone the simplest cosmological ones) are incorporated neither by students nor by elementary school teachers (Gangui, 2007a, and references therein). The subjects tested included the night-and-day cycle, lunar phases, seasons, the nature of planets and stars, meteors and meteorites, among many others.
In our country, science programs for primary school level include the chapter "Planet Earth and the Universe" (AAVV 2004; AAVV s/f), and in there one finds topics in Astronomy and Astrophysics (and even in Cosmology) spanning from Galileo to beyond Einstein, in a clearly ambitious schedule.

2. Astronomical resources

We have recently presented a series of Astronomy and Cosmology books aimed at helping both elementary school students from seven years of age and onwards, and their teachers, in subjects ranging from basic atmospheric phenomena like rainbows and sun-pillars –observable during the day– and the scintillation of remote stars at night, to the relevance played by gravity in the inner functioning of the Sun, and how to think and apprehend the infinite space of our universe.

Fig. 1. Scintillation of stars

Topics like those and many more: the zodiacal constellations –including Ophiuchus–, locating Sirius and Canopus in the sky –guided by a short story–, eclipses, comets and meteors, Kuiper belt objects, the Oort cloud, extrasolar planets, galaxies –and their collisions–, supernova events –and their remnants–, the curvature of space, gravitational lensing, and a long etcetera, are all introduced with

carefully chosen words that young children can understand, with new concepts and definitions signaled by different fonts and colors (Gangui & Bilotti, 2006). Moreover, in each of the four books the text is limited to a maximum of roughly 120 words per double-page and so a main effort was made to condense the most appropriate words to succeed in communicating the precise scientific content.
At an equal footing with the text, the images were conceived by an illustrator working side by side with the scientist. The depth of the illustrations together with the extraordinary mastering of colors and the usage of real images for some collages, make these brief books extremely attractive for children.

Fig. 2. Gravity and stars

3. A couple of examples

Just to give the reader a flavor of the subjects and drawings involved, we show some double-pages related to: the scintillation of starlight (Fig.1), the relevance of gravity in explaining how stars generate energy (Fig.2), and the all important notion of "evolution" (as opposed to "explosion") implied by the Big Bang model (Fig.3; Gangui, 2007b). Many other topics, as well as the few ones mentioned above, are included in the four books.

4. Outlook

In spite of the fact that the books were published fairly recently, we have received positive feedback from many educators who used this material in their science courses. Parents with an eye in Astronomy also communicated their delight with the new tool to convey correct notions to their children.
It is well–known that children arrive in science courses with pre-constructed and consistent models of the physical world surrounding them, and this is particularly true also with general notions of Astronomy. The aim of these didactic books is to help educators to alleviate some common alternative conceptions, and to

explain how to introduce to children many other astronomical and cosmological notions in a simple and cheerful way.

Fig. 3. Evolution and the *Big Bang*

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